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Comparison of post-spinal back pain after midline versus paramedian approaches for urologic surgeries

Payman Dadkhah, Masoud Hashemi, Babak Gharaei, Mohammad Hassan Bigdeli and Ali Solhpour*

Abstract

Introduction: Low back pain after spinal anesthesia is of concern in lithotomy position. During our study, low back pain in both midline and paramedian approaches after spinal anesthesia in lithotomy position was compared.

Material and methods: Spinal anesthesia was performed by two approaches of midline and paramedian by an expert. The midline at middle line and paramedian at 1 cm inferior and 1 cm lateral to the spinous process performed with the needle type of Quincke 25G. The severity of back pain in patients was measured with numerical rating scale method by an anesthesiology assistant 24 and 72 h and a week after surgery.

Results: A total of 139 patients were studied. After 24 h, back pain in the midline group was 21% and in the paramedian group was 25.4%, respectively. There were no significant differences between them. In the first 24 h, the only significant variable was the number of tries. In patients with ≥ 2 times of tries for performing spinal anesthesia, multivariate analysis of patients showed back pain to be 4.7 times more common compared to single try (OR 4.70, CI 1.79–10.18; $p = 0.001$).

Conclusion: There were no significant differences between the two methods of midline and paramedian approaches after spinal anesthesia in the incidence of back pain. However, two or more times of tries compared with one time try had increased risk of low back pain.

Keywords: Back pain, Spinal anesthesia, Lithotomy position

Introduction

Neuraxial blockade has a wide range of clinical applications for urology surgical procedures. Single-injection spinal anesthesia with local anesthetic is the most common procedure in current anesthesia for urologic procedures. Spinal neuraxial blocks result in a sympathetic blockade, sensory analgesia, or anesthesia and motor blockade, depending on the dose, concentration, or volume of local anesthetic, after insertion of a needle in subarachnoid space (Maffulli et al. 1991).

There are two common approaches to reach subarachnoid space. The midline approach relies on the ability of patients and assistants to minimize lumbar lordosis and allow access to the subarachnoid space between adjacent spinous processes (Miller and Pardo 2015). The depth of the dura from the skin in patients of normal body habitus is 5.1 ± 1.0 cm (Gnaho et al. 2012). Spinal needle designs imply the difference in the incidence of post-dural puncture headache and backache and success rate of dural puncture (Pan et al. 2004).

The paramedian approach exploits the larger "subarachnoid target" that exists if a needle is inserted slightly lateral to the midline (Rafiei and Ghergherehchi 2008). The paramedian approach may be especially useful in the setting of diffuse calcification of the interspinous ligament (Mirmansouri et al. 2003). The most common error when using the paramedian technique is that the needle entry site is placed too far off midline,

* Correspondence: solhpourali@sbmu.ac.ir
Anesthesiology Department, Labbafinejad Hospital, Anesthesiology Research, Center, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

which makes the vertebral laminae barriers to insertion of the needle (Barash et al. 2001).

Back injury is perhaps the most feared complication of neuraxial anesthesia among patients (Matthey et al. 2004). Evaluation of the correlative factor of backache and headache after spinal anesthesia shows that approximately 25% of all surgical patients undergoing anesthesia, regardless of the anesthetic technique, experience backache (Haghighi et al. 2012). The incidence of backache increases to 50% when surgery lasts 4 to 5 h (Dickinson et al. 2002). Post-spinal back pain is mainly transient and only lasts 24 to 48 h after spinal. It is associated with the type of needle (Etezadi et al. 2013), drug (Schneider et al. 1993), and duration of surgery and lithotomy position (Breen et al. 1994). In lithotomy position, pressure to dorsal ligaments, joints capsules, and muscles cause an inflammatory reaction in the vicinity structures (Schneider et al. 1993). The aim of this study is to correlate the number of trials and back pain and to determine whether different approaches of spinal anesthesia could impact on the incidence of post-spinal back pain for urologic surgeries.

Methods

Ethics declaration

The study was reviewed and approved by the Shahid Beheshti University of Medical Sciences Ethics Committee. The ethical code is IR.KMU.REC.1394.508. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee. Information about the study was given comprehensively both orally and in written form to all patients or their accompanying adult. They gave their informed written consents prior to their inclusion in the study.

Study design

This study was designed as a randomized comparative study. Randomization was performed based on accidental numbers assigned to each patient by computer.

In this randomized *comparative* study, patients candidate for elective urologic procedure were enrolled and assigned to one of median or paramedian groups; inclusion criteria were age between 18 and 60 with no history of previous low back pain.

Exclusion criteria were duration of surgery more than 2 h and post-dural puncture headache after spinal anesthesia needed treatment. Those with the history of previous back surgery, spondylolisthesis, and other lumbar disorders were excluded from this study. Moreover, those with failure spinal anesthesia were also excluded from our study.

Pain scale was explained to all patients after spinal anesthesia. Patients were pre-hydrated with 5 ml/kg of normal saline.

Sample size determination

The decision to select a proper sample size was based on our single primary outcome. To achieve this goal, a sample size of 40 evaluable patients was selected with 80% statistical power and 30% between group efficacies. Power calculation determined a minimum requirement for 10 patients to be randomized to each group in order to demonstrate a 20% difference in back pain scores with a power of 0.9 and a type 1 error of 0.05. The chi-squared test was used with the alpha level of 0.025 and beta level of 0.20 in hypothesis testing. A total of 168 evaluable patients were selected for this study. Approximately 96% evaluable patients was aimed or randomization purposes with the possibility of 20% drop out rate. The clinical trial was aimed at comparing two methods of approach, requiring the utilization of more than half of the selected sample at the cost of losing the statistical efficacy for the trial.

Allocation concealment

Proper allocation concealment keeps trial investigators and participants unaware of upcoming allocations so that each patient has an equal chance of being assigned to a given group. To achieve this goal, opaque envelopes containing the group each patient would belong to were sequentially numbered and were given to a nurse not been involved in the trial. After a patient consented to the trial study, he or she selected one of the opaque envelopes and was undergone the allocated approach of spinal anesthesia. The opaque envelopes were opened by another anesthesiologist in a sequential manner after the patient's evaluation.

Spinal anesthesia

Spinal anesthesia was performed at sitting position in L3–4 or L4–5 by a single anesthesiologist. Midline approach was performed based on standard technique; paramedian approach was performed by entering a spinal needle in a point 1 cm lateral and 1 cm below the spinous process at 10–15° cephalad angle. Needles were Quinke G25 (Dr. J company) and insertion was made by needle sharp blade cut parallel to the dural fibers. After confirmation of clear CSF flow, bupivacaine 0.5% (2.5 cc) was injected at 0.2 ml/s speed. Then patients were put to a lithotomy position. In this study, those spinal anesthesias which were performed with 2 or more than 2 tries were considered as a separate group compared to those with one try which have been done.

Low back pain measures

The scale of low back pain was attributed to a back pain at the space between T10 and S1 and in between two midaxillary lines with no radiculation. Pain was measured using a numerical rating scale (NRS) by an anesthesiologist at 24 h, 72 h, and 1 week after spinal anesthesia. The scale was from 0 (no pain) to 10 (maximum pain) subjectively measured by patient self-assessment.

The primary outcome measure of this study was the rate of incidence of back pain following spinal anesthesia in two different approaches and the secondary outcome were the severity of back pain and the correlation of the number of tries to perform spinal anesthesia and back pain at 24 h, 72 h, and 1 week after spinal anesthesia.

Data analysis

T test and chi-squared test were used to compare between groups (numeric or categorical variables). Also, logistic regression analysis (univariate and multivariate) has been done to estimate the odds ratio. *P* value less than 0.05 was considered significant. All carried out using the statistical analysis program SPSS 20.0.

Results

In this study, 168 patients were selected, and of them, 11 patients refused to sign informed consent which 90% of them were female. Furthermore, 10 patients due to having a history of previous spine surgery were excluded. Thus, 147 patients were enrolled in this study. Of them, 79 patients are in the midline group and 68 patients in the paramedian group. Three patients in the midline group and 5 patients in the paramedian group were excluded due to failed spinal anesthesia or losing follow-up visits during the study (Fig. 1) There were no significant differences in age and ASA class between two groups of study ($p > 0.05$) (Table 1). There were no significant differences between the type of surgeries performed ($p = 0.396$).

The number of two tries was significantly higher in the paramedian group compared to the midline group ($p = 0.025$). The site of injection was more L3–L4 in the midine group compared to the paramedian group

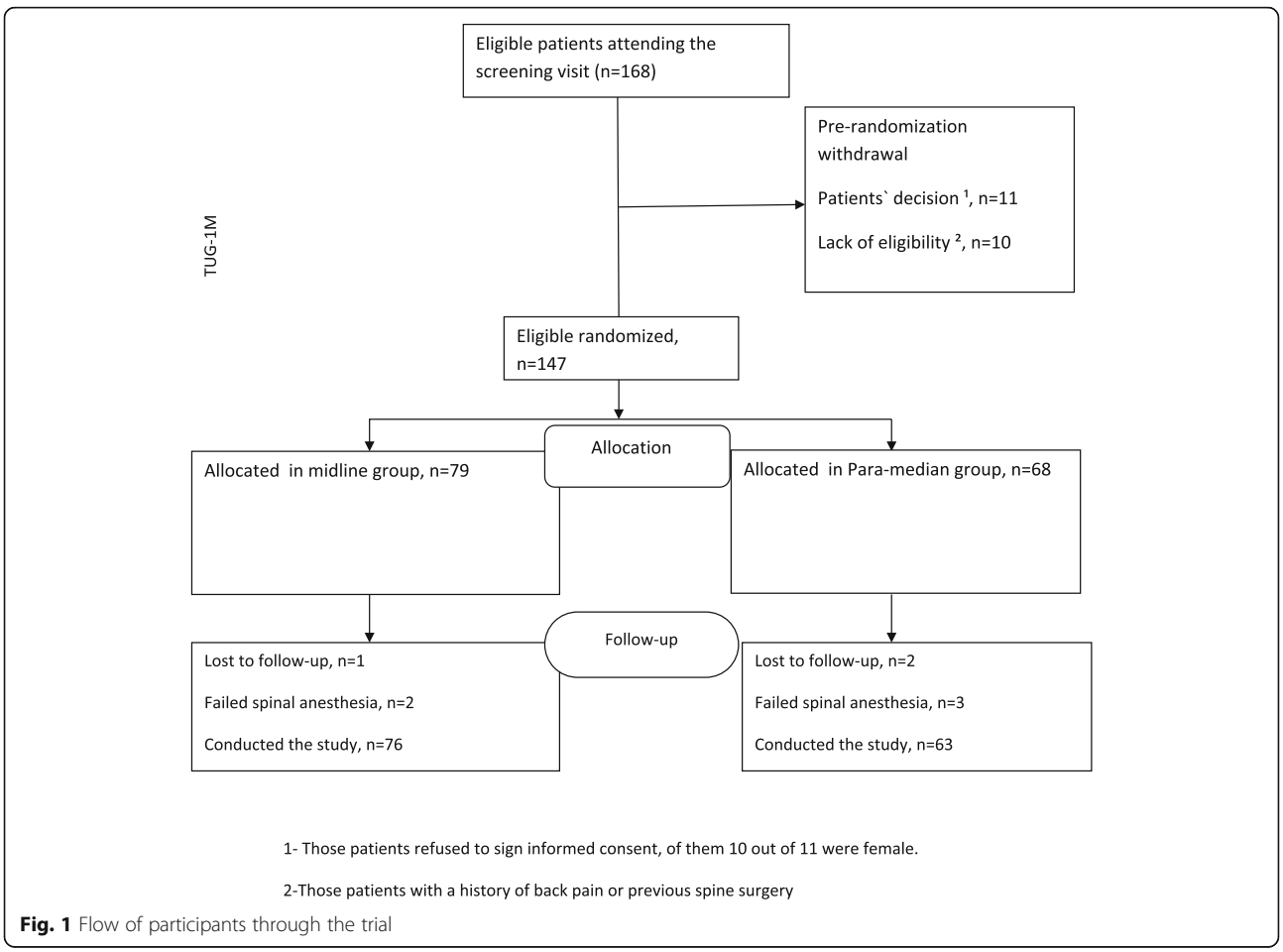

Fig. 1 Flow of participants through the trial

Table 1 Demographic variables in two groups of study

Variables	Median, n = 76	Paramedian, n = 63	P value
Gender			
Male	59 (77.6%)	58 (92.1%)	0.020¥
Female	17 (22.4%)	5 (7.9%)	
Age	47.92 ± 11.75	47.94 ± 12.38	0.927*
ASA class			
I	43 (56.6%)	36 (57.1%)	0.947¥
II	33 (43.4%)	27 (42.9%)	
Surgery type			
TUL	27 (35.5%)	23 (36.5%)	
TURP	6 (7.9%)	11 (17.5%)	
TURT	13 (17.1%)	7 (11.1%)	0.396¥
LILAP	5 (6.6%)	2 (3.2%)	
Other	25 (32.9%)	20 (31.7%)	

TUl transureteral lithotripsy, *TURP* transurethral resection of prostate, *TURT* transurethral resection of bladder tumor, *LILAP* litholapaxy
¥Chi-squared test
**t* test

but was not significant (p = 0.094). The number of patients with induced paresthesia during spinal anesthesia was not significantly different between the two groups (Table 2).

The *incidence* of low back pain was present in 21.1% of patients in the midline group and in 25.4% of patients in the paramedian group. The number of patients with low back pain was not significantly different between the two groups at the first 24 h after spinal anesthesia (p = 0.545). The average pain score at 24 h was not significantly different between the two groups (p = 0.459).

There were no significant differences in patients with low back pain after 72 h between the midline (13.2%) and paramedian group (19%) (p = 0.344). The average pain score at 72 h was not significantly different between the two groups (p = 0.36). None of the patients had low back pain in the two groups after 1 week from spinal anesthesia (Table 3).

Table 2 Comparison between spinal anesthesia techniques between two groups of study

Variables	Median, n = 76	Paramedian, n = 63	P value
Try			
One	56 (73.7%)	35 (55.6%)	0.025
Two	20 (26.3%)	28 (44.4%)	
Injection site			
L3–L4	41 (53.9%)	25 (39.7%)	0.094
L4–L5	35 (46.1%)	38 (60.3%)	
Parestesia	1 (1.3%)	2 (3.2%)	0.590
CSF			
Clear	75 (98.7%)	63 (100.0%)	(> 0.999)
Bloody	1 (1.3%)	0 (0.0%)	

Regression analysis was applied to detect the effect of variables on the presence of low back pain after spinal anesthesia. In multivariate regression analysis and calculating adjusted odds ratio (OR), in the first 24 h, only the number of tries was significantly associated with the incidence of low back pain (Table 4). The OR of having low back pain in the first 24 h was 4.27 times in patients who had two tries of spinal block compared to one try (OR = 4.27, CI 1.79–10.18; p = 0.001). In the first 24 h, the paramedian or median approach had no significant effect on odds ratio of having low back pain (Table 4). The odds ratio of having low back pain in the paramedian group was 0.9 in the midline group which was not significant (OR 0.90; 95% CI 0.37–2.16, p = 0.804).

At 72 h after the spinal block, the number of tries and injection site were significantly related to low back pain (Table 5). The odds ratio of having low back pain after 72 h post spinal was 4.47 in patients with two tries compared to one try (OR 4.47; CI1.61–12.43, p = 0.004). The odds ratio of having low back pain after 72 h post spinal was 4.04 in patients with L4–5 compared to L3–4 (OR 4.04; 95% CI 1.23–13.30, p = 0.022) (Table 5). The odds ratio of having low back pain after 72 h in the paramedian group was 1.06 compared to the midline group (OR 1.06; 95% CI 0.38–2.90, p = 0.917).

Discussion

The incidence of low back pain in our patients at the first 24 h was 21% in the midline approach and 25% in the paramedian approach. The incidence was less than 20% in 72 h after the spinal block which was not significantly different between the two groups. In other studies, the incidence of low back pain has reported 15–45% after spinal anesthesia (Hampl et al. 1995). The effect of needle type, duration of surgery, and position of the patient on the risk of transient neurologic symptoms is debated in previous reports (Etezadi et al. 2013).

The incidence of low back pain was not significantly different between two groups of study neither in 24 h nor in 72 h after spinal anesthesia. Therefore, the severity and incidence of pain was not significantly different between the two groups. This shows that the spinal block approach (median or paramedian) has no obvious effect on the incidence of pain. As a matter of fact, low back pain occurs due to the spinal block and lithotomy position independent of the approach and technique.

By using regression analysis in our data, the only risk factor that increased risk of low back pain was the number of tries (attempt to spinal by anesthesiologist); interestingly, the approach (paramedian or midline) was not a risk factor for low back pain. In patients with two tries,

Table 3 Low back pain in two groups after spinal anesthesia

N (%), pain score (mean ± SD)	Median, *n* = 76	Paramedian, *n* = 63	*P* value
24 h	16 (21.1%)	16 (25.4%)	0.545
	0.68 ± 1.40	0.89 ± 1.59	0.459
72 h	10 (13.2%)	12 (19.0%)	0.344
	0.22 ± 0.65	0.37 ± 0.79	0.360
1 week	0 (0.0%)	0(0.0%)	(> 0.999)

the risk of incidence of low back pain increased approximately 4 times compared to one try patients.

Another risk factor for an increase in low back pain was the level of spinal anesthesia, which the odds ratio of an increase in low back pain in the L4–L5 level was 4 times to L3–L4 patients. The explanation to this finding could be the fact that the ligamentous structures in the vicinity of L4–L5 are more under stretch prone to damage by needle insertion. Besides, the maximum lordosis is at L4–L5, and previous research has showed that spinal block-induced back pain is more common in patients with lordosis (Kopp et al. 2015).

In another similar study on 649 patients under spinal anesthesia, risk factors for low back pain are bony contact, history of low back pain, diameter of spinal needle, and duration of surgery (Tekgül et al. 2015). However, they showed that risk factors are bony contact and history of low back pain, not the two others. They concluded that the method of approach, position, age, and sex are also not significant risk factors. In particular, our results showed that no method of approach including midline or paramedian has any preference to decrease post spinal low back pain.

One important issue that we embarked on was the incidence of low back pain in short-term (24 h) up to long-term (1 week), which were not significantly different at both time-points. The incidence of low back pain in our patients was around 20% in both groups. In other similar studies, the variability of the incidence of low back pain was versatile based on the method, the needle, and position of patients. Back pain and neurologic symptoms are significant side effects in patients having spinal anesthesia with hyperbaric lidocaine, not bupivacaine (Schneider et al. 1993; Keld et al. 2000). Transient neurological symptoms have been observed after spinal anesthesia with 4% mepivacaine and 0.5% bupivacaine (Hiller and Rosenberg 1997). Incidence of backache was significantly higher following spinal using 22 G cutting spinal needle compares to 25 G pencil point spinal needle (Lowery and Oliver 2008). Nerve lesions and back pain after spinal anesthesia depend on using smaller needles and penciled point needles (Selander 2007).

The limitation of this protocol we used in this study to select the patients is that we could not convince female patients to participate in our study as compared to male patients and the informed consent was not signed by certain female patients; therefore, we had a shortage of female participants in our study, but as far as we know, the difference of existence of back pain following spinal anesthesia has not been bolded in a specific gender yet (Tekgül et al. 2015). Thus, this difference would not have a great impact on our results.

In general, low back pain after spinal anesthesia could be a multi-factorial problem. Although the paramedian approach was supposed to decrease the incidence of back pain due to less injury to ligamentous and bony structures; however, our study showed that this could be only part of the story and the incidence of back pain is not significantly different from midline approach. Anatomical changes are observed in ligamentum flavum and are caused by the aging process. These anatomic changes in the lumbar ligaments such as ossification, increase vasculature, and degeneration with abnormal

Table 4 Regression analysis and odds ratio (OR) of having low back pain at 24 h

	Univariate analysis			Multivariate analysis		
	OR	95% CI	*P* value	OR_{adj}	95% CI	*P* value
Gender (male/female)	1.02	0.34–3.02	0.971	1.05	0.32–3.40	0.935
Age	1.02	0.98–1.05	0.336	1.01	0.98–1.05	0.455
Try (two/one)	4.70	2.04–10.84	< 0.001	4.27	1.79–10.18	0.001
Injection site (L4–L5/L3–L4)	2.42	1.05–5.59	0.039	1.91	0.78–4.66	0.158
Group (paramedian/median)	1.28	0.58–2.82	0.545	0.90	0.37–2.16	0.804

CI confidence interval, *OR* odds ratio

Table 5 Odds ratio of having low back pain at 72 h

	Univariate analysis			Multivariate analysis		
	OR	95% CI	*P* value	OR_{adj}	95% CI	*P* value
Gender (male/female)	1.23	0.33–4.57	0.759	1.06	0.26–4.40	0.936
Age	1.02	0.98–1.06	0.347	1.02	0.98–1.06	0.436
Try (two/one)	5.46	2.04–14.58	0.001	4.47	1.61–12.43	0.004
Injection site (L4–L5/L3–L4)	5.07	1.62–15.90	0.005	4.04	1.23–13.30	0.022
Group (paramedian/median)	1.55	0.62–3.88	0.346	1.06	0.38–2.90	0.917

CI confidence interval, *OR* odds ratio

body formation could increase the incidence of back pain (Zaki 2014).

Conclusion

Midline and paramedian approach are not significant risk factors in inducing low back pain after spinal anesthesia. The incidence of back pain was around 20% in both groups. However, 2 times try compared with 1 time try had increased risk of low back pain.

Abbreviations

TUI: Transureteral lithotripsy; TURP: Transurethral resection of prostate; TURT: Transurethral resection of bladder tumor; LILAP: Litholapaxy

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Authors' contributions

PD: gathering data, doing spinal anesthesia, selected patients and analysis. AS: writing the manuscript. MH: gathering data. BG: analysis data. MB: manage study. All authors have read and approved the manuscript.

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Availability of data and materials

The data that support the findings of this study are available from the department of anesthesia in Labafinejad hospital, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the chair of the department of anesthesia in Labafinejad hospital.

Ethics approval and consent to participate

The study was reviewed and approved by the Shahid Beheshti University of Medical Sciences Ethics Committee. The ethical code is IR.KMU.REC.1394.508. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee. Information about the study was given comprehensively both orally and in written form to all patients or their accompanying adult. They gave their informed written consents prior to their inclusion in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests

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